Smoothing-Based Relative Navigation and Coded Aperture Imaging

Completed Technology Project (2016 - 2018)

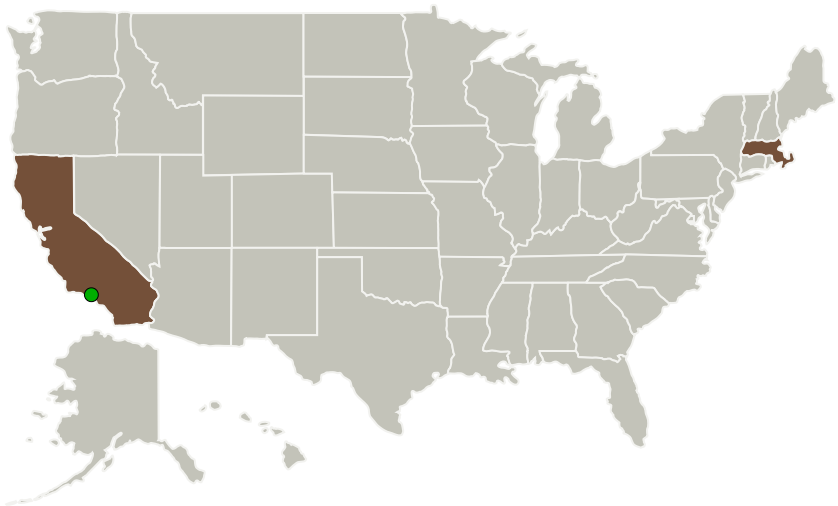
Project Introduction

This project will develop a time-windowed smoothing algorithm for estimation of the relative poses and velocities between multiple, small, and potentially differently instrumented spacecraft. The smoothing algorithm will obtain the most probable estimate of the relative states between the spacecraft by using all available sensor information. It will be portable between different satellite platforms with different onboard sensors, adaptable in the case that one or more satellites become inoperable, and tolerant to delayed measurements or measurements received at different frequencies. It will be matured from technology readiness level 3 to 6 using the SPHERES-VERTIGO microgravity test platform on the International Space Station.

Anticipated Benefits

This technology could help enable constellations of small spacecraft with less sophisticated instruments to fly in close formation by making better use of the available sensor information. For satellite servicing missions, this could be used to enhance the accuracy and precision with which relative pose and velocity estimation is performed, improving the probability of mission success. Inspection of space debris or defunct satellites prior to their deorbit or servicing is a potential commercial application of the proposed technology.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Massachusetts Institute of Technology(MIT)	Lead Organization	Academia	Cambridge, Massachusetts
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

August 2016: Project Start

August 2018: Closed out

Closeout Summary: Achieved real-time execution of Smoothing algorithm on SPHERES VERTIGO computer; conducted 3 SPHERES tests on ISS including clos ed-loop control with smoothing estimate. 4th ISS Test Session (point cloud-base d relative proximity ops) delayed to Nov 2018 due to ISS schedule. Depth from disparity algorithm successfully tested through simulations and lab hardware.

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Massachusetts Institute of Technology (MIT)

Responsible Program:

Small Spacecraft Technology

Project Management

Program Director:

Christopher E Baker

Program Manager:

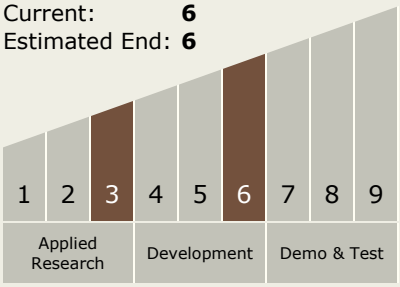
Roger Hunter

Principal Investigator:

Alvar Saenz-otero

Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



Target Destination

Earth